



Los custodios del cielo

CUSTODIANS OF HEAVEN

Treasure Hunt game using geolocation and
augmented reality

Degree in Video Game Design and Development
Final Degree Project's Report

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Este proyecto va dedicado a mis padres,
Los cuales me han ayudado mucho a lo largo de la carrera
Y siempre me han apoyado en los buenos y malos momentos.

Al grupo de monitores de juniors Sant Blai.
Por tantos buenos momentos a lo largo de mi etapa
de monitor dentro del propio grupo
y para el cual va dedicado el proyecto y así poder
aligerar un poco la carga de trabajo en algunos días de sesión.

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1.- Introduction

At the beginning I had several ideas about games I wanted to make between a tower defence style game based somewhat on ancient Greek mythology with mythological monsters walking the path and with the towers based on the powers of some of the gods.

But once I was assigned the tutor I wanted to do something a bit more related to their interests and along with that I decided to try to create an application for one of the groups that participated as a volunteer in my free time.

1.1.- Motivation for work

The game would be designed to be used in the "Juniors M.D." group, which in this case is a type of association linked to the church which works with children from 9 to 15 years old, in which I am sometimes understaffed.

The idea is for the game to make up for the people who would be supervising the different tests in a certain place, so that the other monitors can follow the routes of their group, being responsible for guiding the children along the route assigned to them and without the need for there to be a monitor at each test waiting for the groups to go and do the test and their respective validation of whether they have completed it, given that there always has to be a person responsible for each group of children. On the other hand, the aim is for it to be an entertaining game that can be played outdoors so that not everyone is limited to the place where the activities take place.

1.2.- Objectives

For this project we want to achieve the following objectives throughout its development:

- To have the basis of a game in which players can be guided by geolocation, through some predefined routes that lead to certain points of interest within the locality.
- To achieve that the map screen shows a banner in the approximate place where the test has to be carried out.
- To ensure that the gallery and inventory are displayed correctly so that in the case of the inventory the player has a way to see how they are progressing through the game itself.
- To ensure that the instructions that the group must follow to pass the different tests are well displayed and that these tests can also be dynamic and entertaining for the groups.
- That the objects appear well on the screen on where they would be found by means of augmented reality techniques.

1.3.- General information on the game

1.3.1.- Concept of the game

Custodians of heaven is a video game in which a group would be represented which must find the armour of the dragon rider belonging to their race, after some goblins have hidden the different parts of their armour around the town and the teams must find the different parts that are scattered around the town and must pass a test in each of these.

1.3.2.- Genre

Custodians of Heaven is a union of several genres. The genres from which it draws elements and their motifs are listed below:

- Augmented reality
- Virtual reality
- Ubiquitous gaming

1.3.3.- Target public

Custodians of Heaven is primarily aimed at children in the junior age group from 8 to 15 years old. But it could be played by anyone regardless of age, as it is based on completing simple tests with some aspect of replayability.

1.4.- Información adicional

1.4.1.- Keywords

- Augmented reality
- Treasure hunt
- Geolocation
- Mini-games

1.4.2.- Related subjects

- **VJ1227 - Game engine:** The use of an engine on which to develop the video game.
- **VJ1224 - Software Engineering:** Have an approach on how to go about making the game and follow a structure to be able to complete the design.
- **VJ1216 - 3D Design:** Creation of the different objects that are part of the team of the different characters.
- **VJ1223 - Video Game Art:** Creation of the design of the different characters for their implementation in the gallery.
- **VJ1238 - Foundations for Educational Video Game Design:** The creation of games for a young audience.

2.- Planning and evaluation resources

In this chapter, the more technical part of the work and the planning established for its development will be applied together with the tools and other programmes that have been used in this development process.

2.1.- Planning

Here is the plan that the work has more or less had ([Table 2.1](#)). The one I presented at the beginning had to be changed as I wanted to test it on children, but this was not possible and as I had not planned to incorporate the mapbox tool, the hours of testing it on children were moved to Research and add the map.

Tasks	Time
Modelling the human sword	7 H
Shields modelling	5 h
Modelling helmets	5 h
Modelling of the Cuirass	10 h
Modelling of the Tasset	6 h
Modelling of the Vambrace	8 h
Modelling of the Greave	5 h
Modelling of the Pauldron	5 h
Hammer modelling	5 h
Modelling the elven sword	3h
Texturing of modelled elements	25 h
Drawing of the dragon riders	65 h
Drawing icons and sprites	6 h

Researching how to make and prepare the game for mobile phones	5 h
Prepare the different screens of the game	20 h
Research and add location techniques	20 h
Researching and adding augmented reality techniques	10 h
Research and add the map	12 h
Planning routes	2 h
Developing the tests	5 h
Search and add sounds	5 h
Adding the tests to unity	15 h
Creating the interface	5 h
Test the game	6 h
Prepare the final document and presentation	40 h

Table 2.1.- Work planning

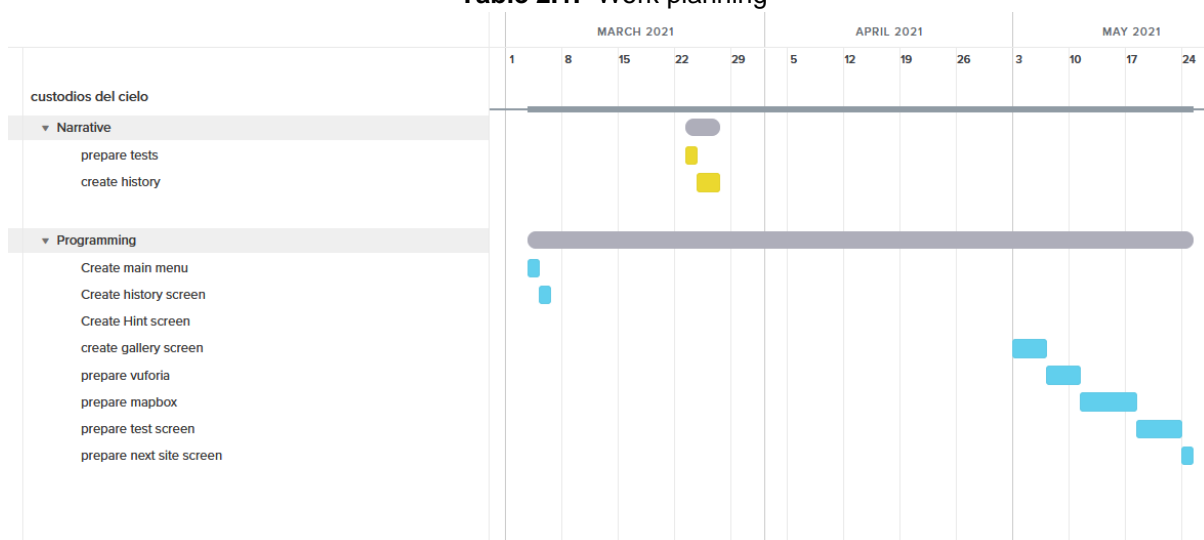


Image 2.1.- Narrative and programming tasks

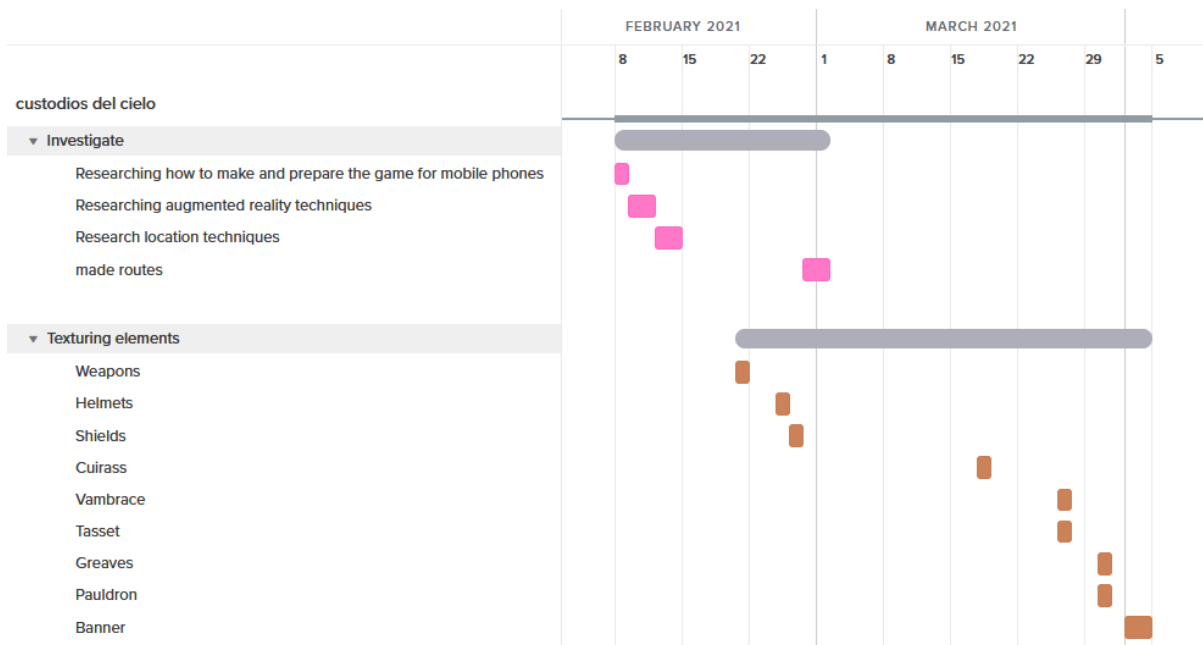


Image 2.2.- Investigate and texturing tasks

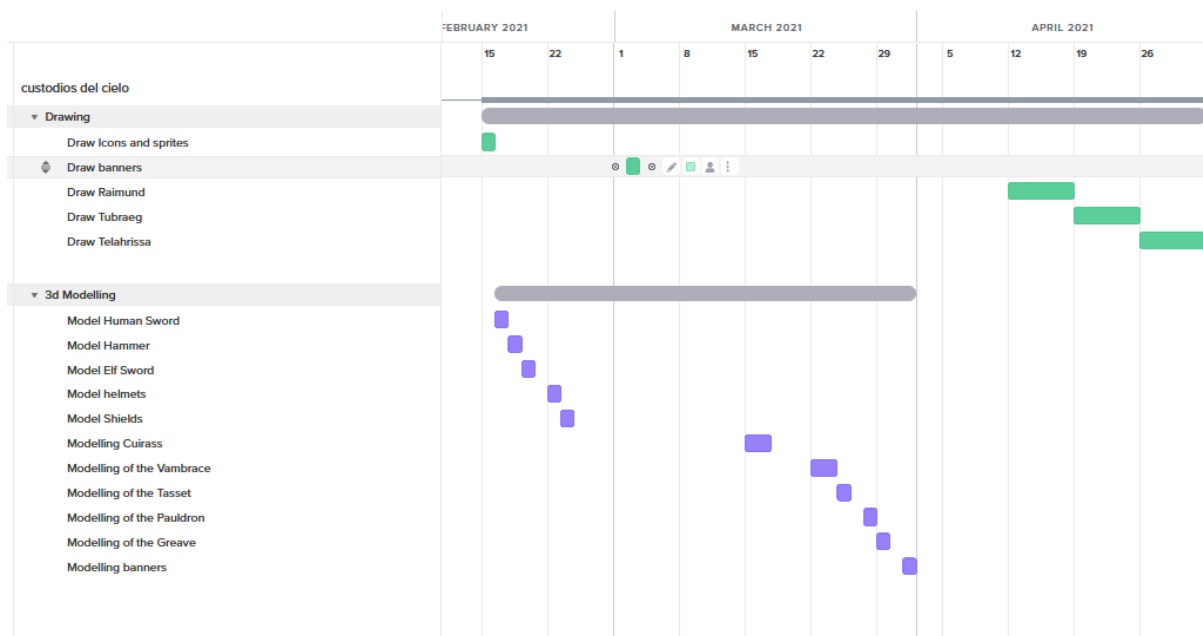


Image 2.3.- Drawing and 3D modelling tasks

2.2.- Expected results

To have the basis for a functional game based on the gamification of tourism itself, which can later be adapted for tourism in the town itself, adapting it to change the routes in the monuments and other places of tourist interest in the town itself. Also to have a type of routes based on the main places of tourist interest with the indications so that they can reach them.

2.3.- Resources used

1. **Unity:** Game engine used to develop the application as it supports development for mobile applications.[\[1\]](#)
2. **Blender:** 3D modelling tool used to create the 3D modelling of the various elements of each character's equipment.[\[2\]](#)
3. **Substance painter:** Tool for texturing 3D objects generated in blender.[\[3\]](#)
4. **Adobe photoshop:** Tool used for the creation of 2D elements from the icon of the game to the characters themselves, in addition to that it has also been used to prepare certain resources that have subsequently been introduced into the 3D models with the help of substance painter.[\[4\]](#)
5. **Vuforia:** Package used within Unity which is responsible for making the augmented reality options work.[\[5\]](#)
6. **Mapbox:** Package used within unity to enable in-game geolocation functions.[\[6\]](#)
7. **Google Spreadsheets:** Tool used for project planning by assigning priorities, seeing what status the different tasks are in and whether any of these are dependent on any other task.[\[7\]](#)
8. **Visual studio code:** Tool mainly used for programming tasks within the project development itself..[\[8\]](#)
9. **PureRef:** Help tool used for drawing and modelling as it allows you to display reference images on your own screen, which you can arrange as you like.[\[9\]](#)

3.- System design and art

3.1.- Artistic design

Mainly within art, we have tried to implement several signs of identity of the juniors in general and of the centre itself.

On the one hand we have the choice of colour, most of the elements of the game have some colour belonging to the Juniors M.D. Sant Blai centre's own scarf ([image 3.1](#)). For this centre the colours would be:

- The scarf has a red background
- An outer line of blue
- An inner line of yellow.



Image 3.1.- Centre scarf

On the other hand, we have the other element which is the chrism ([image 3.2](#)) which is on the banners themselves, which in this context would be an identifying part of the order of the dragon riders, as well as being incorporated into some of the modelling of the equipment of the characters.



Image 3.2.- Chrismon

3.1.1.- 2D Art

The main icon of the game ([image 3.3](#)) is designed as a union of different elements of the equipment to be obtained, these being the sword of the human race character in blue, the hammer of the dwarf race character in red, and finally the shield belonging to the elven race in yellow.



Image 3.3.- Game Icon

Each character will have their own banner which represents their kingdom of origin or clan.

The human banner ([Image 3.4](#)) is represented by the figure of the phoenix for its characteristic of rebirth, in this case I have included it for its meaning of continuing to strive despite the many failures that can be made and to try to overcome without fear of failure.



Image 3.4.- Human banner

The elven banner ([Image 3.5](#)) is characterised by the presence of a stag on it, referring to their ties with nature. It also has a sword to remind the people that despite their benevolence they would do anything to defend their domain and way of life.



Image 3.5.- Elven banner

The dwarven banner ([Image 3.6](#)) is represented on the one hand by the presence of axes and hammers, referring to their warlike character, and their great skill in both mining and jewellery making. On the other hand, the 12 stars that surround him symbolise the union of the 12 different dwarven clans.



Image 3.6.- Dwarf banner

Raimund is the character belonging to the human race, his equipment is mainly characterised by his blue base and some yellow/gold details ([Image 3.7](#)). When we start the game we can see him as he has nothing more than his clothes, this corresponds to the part of the image on the left, and as the tests progress we can see how he gets his different parts [\[10\]](#) and once they are all obtained we can see the character as he is when he has all his equipment on, as can be seen in the image on the right.



Image 3.7.- Raimund's status

Telahrissa is the character belonging to the elf race, her equipment is mainly characterised by her yellow base and some green details ([Image 3.8](#)). When we start the game we can see her as she has nothing more than her clothes, and as the tests progress we can see how she is getting her different parts [\[11\]](#) and once they are all obtained we can see the character as she is when she is wearing all her equipment

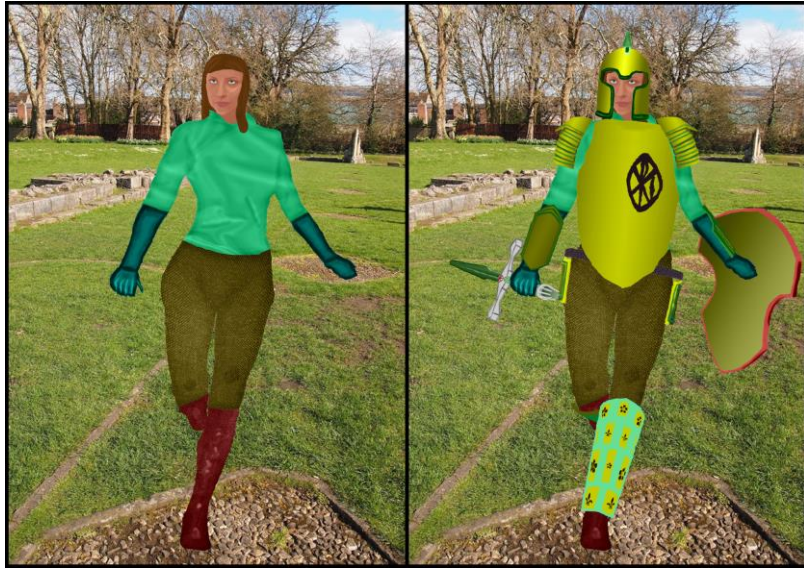


Image 3.8.- Telahrissa's status

Tubraeg is the character belonging to the dwarf race, his equipment is mainly characterised by his red base and some details in brown/bronze and in some cases even purple ([Image 3.9](#)). When we start the game we can see her as she has nothing more than her clothes, and as the tests progress we can see how she is getting her different parts [\[12\]](#) and once they are all obtained we can see the character as she is when she is wearing all her equipment.



Image 3.9.- Tubraeg's status

Boards which I have had to include in order to maintain a certain logic with the style of the game itself ([Table 3.4](#)). To begin with, we have the notice board itself ([Image 3.10](#)), which would be used to enter the different texts that will be used throughout the game. On the other hand, there is the papyrus ([Image 3.11](#)) where the texts are to be inserted. Then there would be the poster ([Image 3.12](#)) which is designed to always be placed at the top of the screen. Finally, there would be the stand ([Image 3.13](#)) and the board ([Image 3.14](#)) which is foreseen to be used for the creation of menus and buttons.




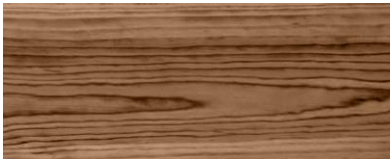

 <p>Image 3.10.- Notice board</p>	 <p>Image 3.11.- Papyrus</p>	 <p>Image 3.12.- Poster</p>
 <p>Image 3.13.- Support</p>		 <p>Image 3.14.- Post</p>

Table 3.4.- Posters

3.1.2.- 3D Design

The equipment that Raimund carries in the game is mainly composed (Table 3.5) by:

- A sword which has a small inscription on the handle, in turn the blade was made of two metals being silver on the outside and iron on the inside. Its handle is covered in leather,
- A Cuirass which also has some symbols painted on its front.
- A Tassetis composed of a belt which serves to support the metal plates of which it is composed.
- Pauldron formed $\frac{1}{4}$ of a sphere and with two curved parts to give flexibility when the shoulder moves.
- Greaves that have a scale-like texture and are made of metal.
- A wedge-shaped shield that also has some symbols painted on the front of it made entirely of painted metal.
- A helmet made entirely of iron.
- A vambrace made entirely of iron which has 2 reliefs on the top and bottom of it.

In addition to this is the banner that will be linked to this character which would use as a support a spear made entirely of metal to which is attached the fabric flag that has some damage in the part where the banner is not the character's banner and is part of the padding of this.

Sword	Cuirass	Tasset
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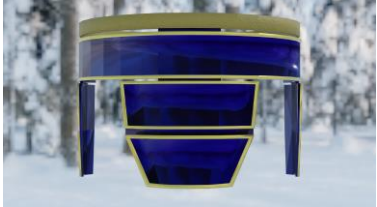



		
Pauldron	Banner	Greave
		
Shield	Helmet	Vambrace
		

Table 3.5.- Raimund equipment

The equipment that Tehlarissa carries in the game is mainly composed ([Table 3.6](#)) by:

- A sword that has a symbol painted on the guard part which is made of silver, the blade would be painted in green colour symbolising nature and on the pommel part it has an emerald inlaid.
- A Cuirass with a painted symbol over the heart is made entirely of metal and is wedge-shaped.
- A tasset which is composed of a belt which serves as a support for the metal plates that will be placed on the sides of each leg.
- Pauldron, which would have an incorporated symbol is made of a cubic shape with a small spike in the middle of it, which in turn is made of 3 other curved pieces of metal to give it flexibility when the shoulders move.
- A greave that would have a grid formed in the front part and in each cell has a symbol painted on it and would be made entirely of iron.
- A shield in the shape of a leaf and which is divided into 4 parts would be made of iron and some of the paintings that would be done on it are inspired by tones belonging to elements of nature.
- A helmet made of metal with a metal crest incorporated in the upper part.
- A vambrace made of metal and embossed along its front surface.

In addition to this is the banner that will be linked to this character which is made of two wooden rods which are held together by ropes and on one of these is the banner which has a background of green base colour of this with red tones.










Sword	Cuirass	Tasset
		
Pauldron	Banner	Greave
		
Shield	Helmet	Vambrace
		

Table 3.6.- Telahrissa Equipment

The equipment that Tuareg carries in the game is mainly composed of ([Table 3.7](#)):

- A hammer which has the symbol on each side of the head of it, the head is made of metal, while the handle is made of wood and divided into 2 parts, the part where the hammer is supposed to be gripped has a metal knob on each side and on the part is the wood is painted to give it the shape of scales.
- A cuirass with the symbol in the centre surrounded by a star for each dwarven clan, made entirely of metal.
- A tasset composed of a belt which will support the 3 metal plates that compose it, a central one and two lateral ones, all of them with symbols painted on the outside of them.
- Pauldron are composed of a $\frac{1}{4}$ sphere and 3 curved metal parts to give flexibility when moving the shoulder. All parts are made of metal and painted in red, purple and brown.
- Greaves made of metal and embossed with painted symbols inside each section.
- An octagonal shaped shield made of wood and with metal reinforcements dividing each section of the octagon with an equal symbol painted on each of the cardinal points and between each of these has a different painting.

- A helmet made of leather and reinforced with some metal.
- A vambrace made of metal and with reliefs.

In addition to this is the banner that will be attached to this character which is composed of a metal spear and a piece of metal that will serve as a support for the banner..




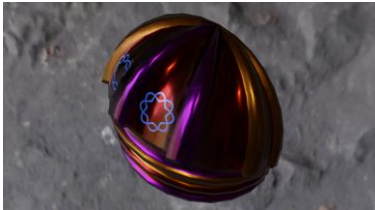




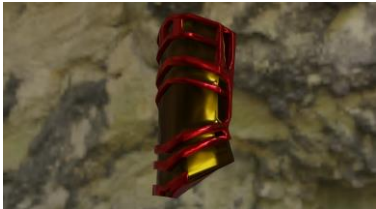
Hammer	Cuirass	Tasset
		
Pauldron	Banner	Greave
		
Shield	Helmet	Vambrace
		

Table 3.7.- Tubraeg Equipment

3.2.- Game design

3.2.1.- Mechanics

On the one hand, the game has a mini-game mechanic which is mainly based on the fact that in order to pass these tests, no external element other than the mobile phone itself is necessary.

There are also some tests that have been designed to take place in a specific place as they are in a large place so that they can be developed without disturbing people and have enough space for example to run, in addition to this area there is usually no traffic and so it will not be possible to interrupt or have problems with traffic and in case of going in a group to go quietly from one place to another.

On the other hand, some of these mini-games were intended to have a certain didactic character within what would be part of the junior movement itself or things of general culture.

Some of the tests proposed for this game can be seen in [Annex 2](#).

In addition to this, the players will have to go through some predefined sites ([Image 3.15](#)) ([Table 3.8](#)) within the town itself and these belong to the part of the old quarter, once they arrive at these sites through the use of augmented reality they will have to find the object they are looking for,

Most of these are chosen for their historical part or for the ease of being a pleasant environment for testing. On the other hand there are some that have been chosen because of the direct relationship they have with the Juniors M.D. movement within the town itself.

Each team will have its own route made up of 8 different points and a final meeting point ([Annex 3](#)) which will be the same for all of them, where they will have a conclusion and a short reflection on the activity.



Image 3.15.- Map of sites to visit

Name	Number
Patronato	1
Monestir	2
Plaça Sant Tomas	3
Llavador	4
Mare de deu del Desemparats	5
Torre dels portuguesos	6
L'Aljub	7
Mirador pont	8

Carrer del Batle	9
Placeta de la presso	10
L'Emboç	11
Placeta lleó Ibèric	12
El tou	13
La calça	14
Parque cantereria	15
Plaça cantereria	16
Parque Barri medieval	17
Ermita mare de déu dels Desemparats	18
Portal	19
Mirador	20
Iglesia	21
Pont Medieval	22

Table 3.8.- Name of sites

3.2.2.- Interface

Main menu

The first screen that can be viewed once the application has been opened. From this screen we can start with the story of the game or access the gallery to see the characters and how the player carries them.

As we can see below ([Image 3.16](#)), this screen is divided vertically into 3 parts, the top part is made up of the game icon and the title, while the other two parts are made up of supports to create a fence and between these supports are the buttons, which are in the shape of a board. With the first button we will go to the first story screen, the second one will take us to the gallery, while with the last one we will be able to exit the game.

As we can see in [Annex 4](#), some playerprefs are started here, which will allow us to save game data even when we exit the game itself.

In addition to that, this screen will play a musical theme set in a medieval market.



Image 3.16.- Main menu screen

History screen

This screen is used every time you want to introduce some narrative element of the story itself, which will mainly be the introduction ([Annex 1](#)) that the players will receive to place themselves in the narrative context of this ([Image 3.17](#)) on the left side, then it will appear again when the group or player has selected the character they want to play with, which will give them a description of their story and how they have reached this point, as can be seen on the right side of the image, and finally it will appear again at the end of the game, as a group outcome is desired, the conclusion of the story of all the characters will be explained jointly ([Annex 1](#)).

As we can see in the image on the left side is the starting text and the one on the right side is an image of the same screen following the course of the game itself until after selecting the character we want to take. The person responsible for changing this text can be seen in [Annex 4](#).

In addition, within this screen we will have an instrumental theme of the quiet period so that the person in charge of reading the story has some accompaniment for the reading of the story that appears on the screen.

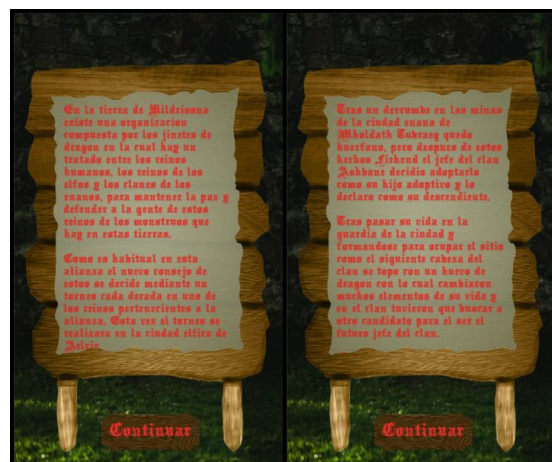


Image 3.17.- History screen

Gallery and inventory

Screen where we can see which parts of the characters' equipment we have obtained so far ([Image 3.18](#)), as shown in this screen the player has obtained different objects from each of his characters.

The operation of the images is based on a background image of each of his characters which can be seen in [point 3.1.1](#), while each component of the equipment is represented by a sprite with only that part of the equipment in .png format [\[13\]](#).

The status of each part of the equipment that the user has obtained is stored in a separate Json file for each character in the game, this Json is in [Annex 4](#). And then there is the own script manager of this screen which is in charge of deciding by means of what it receives from the Json files the sprites that have to be enabled for its correct visualisation as it can be seen in the code inside the [Annex 4](#).



Image 3.18.- Gallery screen

Character selection screen

Within this screen we can choose under the guidance of which character we can complete the game ([Image 3.19](#)). This choice is made by choosing the character's banner. Once we have chosen the character to be created, we change the necessary values within the playerprefs, which would be the chosen character, the character's story that must now be shown in the story screen that you access and also assign that the gallery becomes an inventory type so that the buttons to change the character are not shown, as we are now only interested in the selected character.

Once all the changes have been made, we will return to the story screen but this time showing that of the selected character.

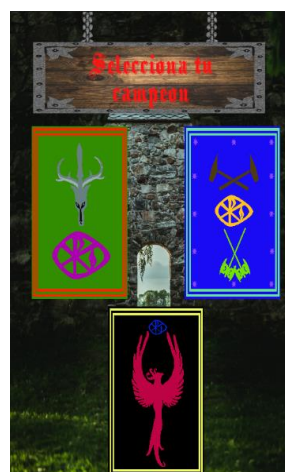


Image 3.19.- Character selection picture

Test screen

Within this screen we will have the text and the other components to pass the test ([Image 3.20](#)). At this point in the game, each player will have his or her character's banner as a wallpaper.

On the one hand we have the title in a poster at the top with the name of the test in question, then inside the text post at the top we have a small description of the test, and in some cases this is the end of what is inside the poster, while in other tests we have the resources or aids necessary for the development of the test, as in the case of the riddles where we have the question to be asked and the solution that the person who validates the player has to provide.

Then there would be the variant that has 2 extra buttons that would be for those that have something to play some audio, being these to start and stop the sound.

And finally in the part we will have a button for when this is completely overcome and to be able to continue advancing through the game.

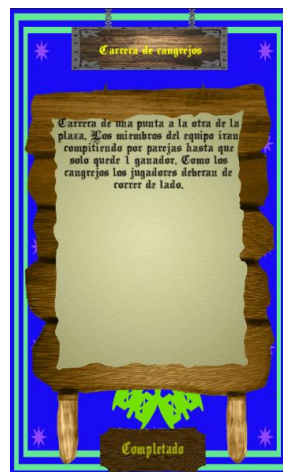


Image 3.20.- Test screen

Next site screen

This screen ([Image 3.21](#)) is a help screen for players, where they will be given a little help on where to go to get the next component of their character's equipment. It is composed of the background screen which would be your character's banner, a board in the centre giving the clue to the site and a button to continue and advance to the map screen.

The clues to these sites can be found in [Annex 3](#).



Image 3.21.- Track to the next site

Map

This screen ([Image 3.22](#)) is used to see where the player is going and to display the player's banner at the place where he is currently moving to.

In addition, at the top right of the screen there is a button which allows you to go to the inventory and see the part of the equipment that has been obtained so far.



Image 3.22.- Map

Camera

This screen only serves to search through augmented reality for the part of the equipment to be found, once found, you can go to the test screen to actually get it.

4.- Game design document

4.1. Gameplay and mechanics

4.1.1.- Gameplay

The game will consist of having to go to a certain point to get the parts of the equipment of the hero they represent, once in the place they will have to pass a certain test to obtain it. The test will come up once you click on the part of the equipment, it will have an explanation of what it will consist of and an option to select when it is completed.

The game will work almost entirely through buttons or by clicking on the part of the team. On the other hand, the intervention of several people would be necessary (being possible in the future to change the tests) so that there is at least someone who can validate that the tests have been passed.

When starting the application, the screen shows the game logo and two buttons, one of which will help us to go to the gallery, while the other will help us to start the game through an introductory story about the events in the fictitious world that have triggered the events of the game itself.

Once this introduction has been completed, each team will have to select their representative, after which they will be given a brief explanation of the situation of the character they have chosen. Once they have done this, they will be given a clue as to where they need to go to perform the next test they will have to perform to obtain the piece of equipment. They will have to head to 8 different locations to which once they are close on the map screen, a banner will appear to indicate that they are close to the site and after this, through the camera they will have to search for the piece of equipment in question. To achieve this, a text will be displayed with indications of the test to be carried out. Once they have passed the test, they will be given a clue as to where to go next.

Once these have been completed, a 9th will be shown, which will take them to the final test which, if it is done in groups, will be carried out jointly by all the teams, while in the future or if it is not possible to do it jointly, a different test will be carried out which they can do, and once completed, the result of the story of the different characters will be explained to them.

The flowchart of the application itself can be found in [Image 4.1](#).

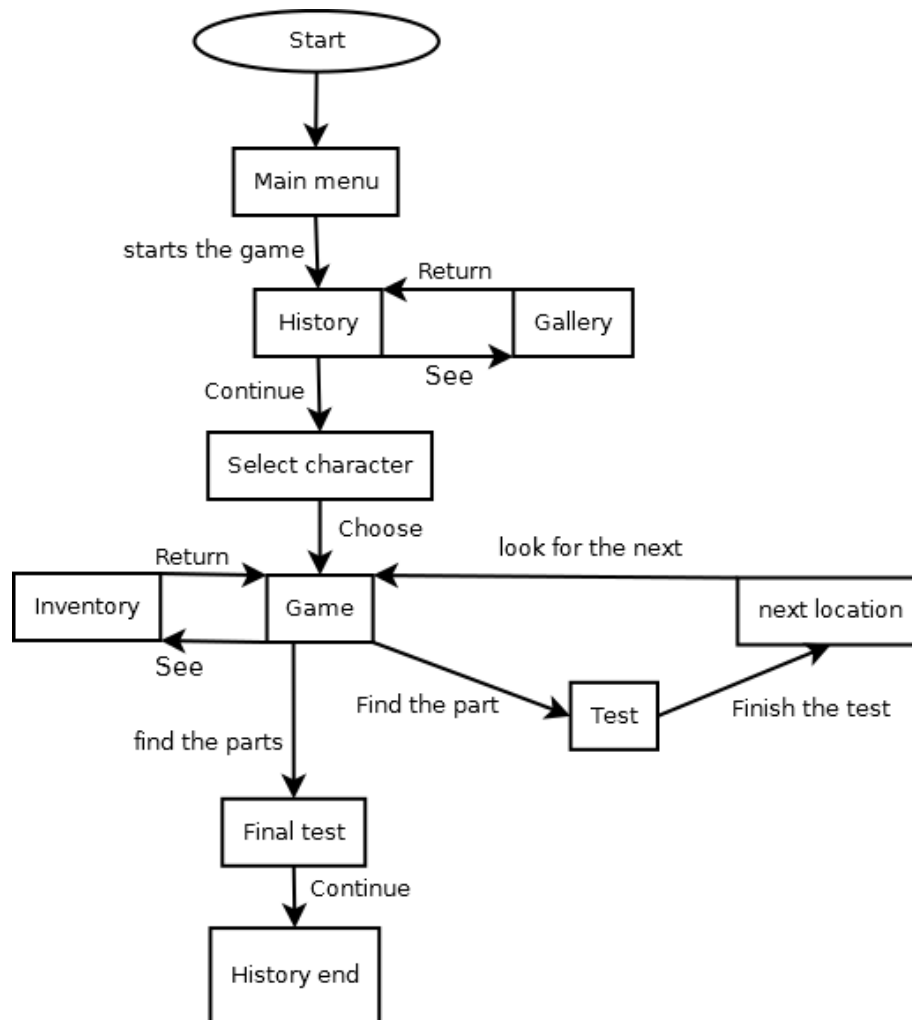


Image 4.1.- Game flow

4.2.- History

4.2.1.- World

It is set in a fantasy world where various races coexist with each other while there are also some evil creatures or other races within this world along with the existence of magic. To maintain order among the humans, elves and dwarves is the organisation of the dragon riders, an order independent of all the kingdoms of these races, who answer only to the council of the order which is renewed from time to time through a tournament that is organised by the retiring council.

To be part of the order the person has to be chosen by a dragon egg which in the presence of its rider hatches and forms a bond with it, giving it certain unique abilities. Once chosen and at an adult age they will be allowed to enter the rider's academy where they will carry out their training until they graduate from the academy. Once they have completed their training they are placed under the care of a mentor who will help them gain experience in the real world, once they are deemed to have completed their training they will become a fully fledged rider.

Each time the council is renewed, the members of the council elect some candidates for the tournament in order to be part of the new council, and if they are admitted by some members of the council and other members of the order itself, they can also present themselves as candidates for the new council.

4.2.2.- Characters

Raimund

Raimund was abandoned as a newborn and left on his aunt Ishmeldi's farm. One day while hunting in the forest he found a dragon's egg in the middle of a clearing.

Some time later, after finishing his training at the horsemen's academy, he was assigned Galstinit as his supervisor to finish his training.

One day during a scouting mission in the lands of Einverth, they were ambushed by a group of Yerbdrug, during this attack Galstinit was badly wounded and they had to retreat to the fortress of Razhgrosh in search of medical help for Galstinit and other riders and soldiers in order to eliminate this threat. After this Raimund was no longer an apprentice but a fully fledged horseman.

After more than 2 decades of service he is given for the first time the opportunity to take part in the tournament for a place in the council.

Telahrissa

Telahrissa was a diplomat in the elven kingdom of Vrendraoch under the reign of Queen Shiarionee. In the course of one of her diplomatic journeys she came across a dragon's egg.

After this he had to leave his diplomatic duties to enter the horsemen's academy, but before that he helped with the preparations for who would take his place after his departure. He also helped with the selection process since after so long in that job he knew the necessary qualities and had some possible candidates for the job.

After finishing her studies at the academy, she was placed under the supervision of Vosnedith. After finishing her training with Vosnedith, she returned to work as a diplomat, but this time under the orders of the horsemen.

After several decades of diplomatic work and helping new riders complete their training, she was given the opportunity to participate in the tournament for a place on the council.

Tubraeg

After a collapse in the mines of the dwarven city of Mholdath Tubraeg was orphaned, but after these events Firhend the head of the Ashbane clan decided to adopt him as his adopted son and declared him as his descendant.

After spending his life in the city guard and training to take his place as the next head of the clan he stumbled upon a dragon's egg which changed many elements of his life and the clan had to look for another candidate for the future head of the clan.

After completing his training at the academy he was placed under the supervision of Ulzix to finish his training.

After completing his training he decided to devote himself to forging and researching new types of magical weapons. After several decades he was given the opportunity to participate in the council.

5.- Work progress and results

5.1.- Development of the work

5.1.1.- Technical development

This has focused on one hand on the creation of the different screens based on a certain logic that can be pleasing to the eye and on trying to optimise their functioning in the best possible way.

In addition, this stage in certain points of the development was dependent on the artistic phase since, for example, if the sprites of the gallery were not done, it was not possible to check if it worked correctly. On the other hand, there have also been some points dependent on the narrative or other elements such as the approach to the tests, because until I was clear about the tests I wanted to introduce I haven't done anything related to the theme of the mini-game screen.

There are some points where the main ideas about some screens have been changing because some were not planned and came from the need to establish a link between some points within the application and the need, such as the screen to indicate the next site because in a way it was planned as a pop-up message on the map screen, but then this was made in a separate screen because it gave some time to think about the site before launching and go to the site directly.

While on the other hand I decided to merge what were originally 2 gallery screens, as I thought that these being very similar could be simplified into just one screen and enabling or disabling those parts through code.

On the other hand, some approaches have been changing with respect to some data, since in some cases it has been unnecessary for the moment to include them in Json, since being constants they could be put only inside the code, as it would be the case of the tracks, since they are always the same, they are embedded inside an array inside the code that is in charge of managing this screen.

On the other hand we have tried to maintain the coexistence of all the elements of the game as the mapbox which is basically an api focused on helping developers in elements related to navigation in the real world and vuforia is compatible with the version of unity used for the development of the application,

For the vuforia part I followed some videos that I found in a youtube channel which focuses a lot on the use of vuforia inside unity [14]. While for the implementation of the mapbox related issues I have followed a playlist [15] in making a game quite similar to pokemon go, therefore I have had to adapt in some points some parts to fit better with my game idea.

5.1.2.- Artistic development

The art development has also been divided into two main parts, one in charge of all the 2D design and the other responsible for the 3D objects.

Within the 2D design there are some independent factors such as the menu poles that were simply raised as a way to maintain the logic in a medieval approach, then there is the design of the banner which was a main point before some modelling and then it was decided to incorporate them as wallpapers for some screens, as it was initially planned to use medieval themed images.

Finally, there are the drawings that depended on the 3D modelling, and while these were not finished, they were not drawn on the character with its pose already established, which also had to be planned to be drawn in a specific order without disturbing any other component of the character's team.

Within the 3D modelling, only 8 were initially planned for each character, but as the evolution of the game progressed, it was decided to add a final test for the possible conclusion of the story and later to implement them within what would be the minimap of the game. The process of creation of these objects was to first look for some reference objects and that all of them were only for one character without reusing any of them in another one. Once it was clear how the object was wanted, it went to the modelling stage inside blender. Once this was done, the object was passed to substance with a certain approach of how it would be textured. Once this process was done, it was ready for its 2D drawing inside the character.

5.2.- Results

To begin with I regret that due to the health situation I have not been able to test with the children as they are the ones who would give me the best result on how the application has turned out and with their opinions we could see how to improve it a lot, let's see if in the next course I can test it with them even a version with some improvements and variety and more refined.

To finish with the topic the application is quite similar to the result that I wanted in the beginning although as it is said always it is possible to improve these and to implement new things. In addition this application has served me to discover tools that I didn't know as vufoia and mapbox, but in some of these for the moment I would like to continue investigating for alternative tools that give me a similar result, since at the moment these versions of the sdk that I use to be free and of limited use are quite limited, as it is normal in this type of products. Seeing some possibilities of these, maybe in the future I will change some parts of the application. As far as I can see mapbox has been quite difficult to implement.

I would also have liked to make the game a little longer because with the tests that I did it was about 50 minutes to complete it all, overcoming the tests and going through the different sites, it should also be said that maybe walking with the children could be a little longer but that still would not be quite enough because in theory the sessions that we do with children last an hour and a half.

6.- Conclusion and future work

6.1.- Conclusion

The game is quite similar to the base we wanted to reach with this game, although I have to admit that some mistakes have been made in its approach. The main of these failures has been to want to implement from the beginning things that are wanted for the future work on this game, in some cases complicating its development, which should have started as the simplest base of this game and once achieved that base start with the changes that you want and go complicating it.

On the other hand in the artistic part in my opinion the big problem is with the drawing of the faces of the characters which with a little more time and looking at them well I would like to change them. But I quite like the result that has been obtained from these drawings of characters and the fact that they have been able to have a little dynamic pose and the fact that they have been able to make them advance until they have all their equipment already drawn.

Then I liked the part of having total narrative freedom and being able to create a world with the inspiration of saga like Eragon and Star Wars in certain aspects of the story. It is the first time that I create some characters with their own stories and with some goals to achieve and I liked this point because I could have all the freedom I wanted to create it and make my own that fantasy world which in the future I would like to continue increasing.

Then I had to decide to incorporate mapbox because only with vuforia I couldn't get the coordinates to work and I don't like it at all because with mobile devices these will never be completely accurate and can vary depending on the device or some interferences which could make them get lost, on the other hand I did not like some videos of how this function is implemented only with vuforia since I found it quite unnatural as this was on screen and so I decided to apply it on photos which at first these took quite a few years to be replaced either by wear or other form that acquire some sites used as a reference.

Within what would be the 3D art I would also have liked to have a little more harmony with some styles and that's why I want to do them again in the future because there are some that I don't like and in another aspect I think I should use some kind of reference so that all these have an approximate size because doing them independently has ended up causing that later these in unity have a different size between them than you would expect.

6.2.- Future work

With this functional basis of the game, what we now want to do is to divide the game into two different parts, these in turn could be within the same application but divided into a screen where you can choose which type you want to play or on the other hand they could be independent applications each with its own game mode, an aspect for tourism, while maintaining and improving the didactic and playful part for groups. Some proposals for improvement or change would be:

1. Add the possibility of making the player leave the game and resume it whenever he wants, it is not a total implementation since in a way it is already done and it would only be necessary to modify a little the main menu and the character selector.
2. Add a new game mode completely based on going to places and getting the equipment part without the need for mini-games.
3. Add a system that generates the route with the sites to which the person has to go with random values and another in the type of mini-games to assign some tests randomly, it could be done

that some sites have some predefined tests and when the route is being built these tests are assigned avoiding repetitions.

4. A type of game in which you indicate a number of sites to visit, all of them within a range of minimum and maximum values and then start a game with some random sites to visit.
5. Change the functioning of the map system so that the chosen character can be seen advancing through the map.
6. Change the functioning of the gallery system so that instead of a drawing of the character you can see a 3D representation of the character with the different elements equipped inside the modelling.
7. Add new tests that keep the general rule of the tests, which is that in order to pass them, no extra material is needed for them to be passed.
8. Add new characters and some themed as events based on certain local festivals such as "Moors and Christians" where they can get the clothes of any of the 9 rows that are part of the party itself.
9. Make a free play mode in which the available places to get the equipment are shown and the player can go to the ones he/she is most interested in.
10. Make another gallery but this time of sites with the image of the text and some description about the place itself.
11. Take the application to the town council and talk to certain people in charge of tourism to see how this game could be implemented to gamify tourism in the town in a certain way and see if it is possible to do something like this on social networks.

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Annex

Annex 1

Initial story

In the land of Hildriosna there is an organisation made up of dragon riders in which there is a treaty between the human kingdoms, the elven kingdoms and the dwarven clans, to keep the peace and defend the people of these kingdoms from the monsters in these lands.

As usual in this alliance the new council of the alliance is decided by a tournament every decade in one of the kingdoms belonging to the alliance. This time the tournament will be held in the elven city of Aelrie.

The representatives for the position of leader in this tournament are:

- Tubraeg from the Ashbane clan of the dwarves and rider of the dragon Gikolfr.
- Tehlarissa from the kingdom of Dionzith of the Elves and is the rider of the dragon Deralneash.
- Raimund from the kingdom of Douma of the humans and rider of the dragon Imurvesh.

But this time something unexpected has come up and before the start of the tournament a group of goblins have entered the citadel and have taken the equipment of the riders and have decided to hide it in different parts of the city.

As members of their retinue you must help your rider to gather the pieces of their equipment which consists of:

- A shield
- A weapon
- A helmet
- A Cuirass
- Pauldron
- Vambrace
- A tasset
- Greaves

It is up to you to ensure that your rider can participate in the tournament.

Final story

When everyone arrived at the square with their team. The current council informed the participants that this is really a test of teamwork and leadership.

After the other tests were completed, Tehlarissa was made the leader of the council, Tubraeg was made the scientific leader in charge of the creation of magical weapons, development of new potions and new uses of certain magics. While Raimund was tasked with supervising the new recruits and running the academy itself and entrusting the recruits with their new tutors to complete their training and deciding when they have completed their training.

Annex 2

Test 1

Carrera de una punta a la otra de la plaza. Los miembros del equipo irán compitiendo por parejas hasta que solo quede 1 ganador. Como los cangrejos los jugadores deberán correr de lado.

Test 2

Recita la poesía de "Caminante no hay camino" de Antonio Machado

Caminante, son tus huellas
el camino y nada más;
Caminante, no hay camino,
se hace camino al andar.
Al andar se hace el camino,
y al volver la vista atrás
se ve la senda que nunca
se ha de volver a pisar.
Caminante no hay camino
sino estelas en la mar.

Test 3

Adivina el nombre de la siguiente canción que está sonando

Ley junior → <https://www.youtube.com/watch?v=IQUOhrh1wPI>

Oracion junior → <https://www.youtube.com/watch?v=3gLPEXWjPuk>

Quiero → <https://www.youtube.com/watch?v=yKXXMYaEDFk>

Panyoletes i crismons →

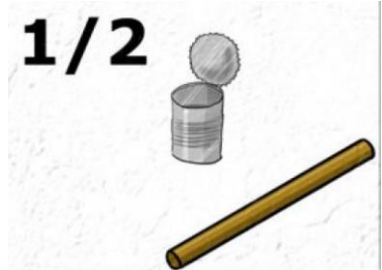


<http://recursos.juniorsmd.org/Otros%20Recursos/CANCIONERO/15%20JUNIORS/105.%20Panyoletes%20i%20crismons.mp3>

Test 4

Canta libremente al compás de la musica que esta sonando

Test 5

Adivina el significado de los siguientes jeroglíficos

Me dio la tabarra	Casaca	Holanda
	<p><i>ES UNA PRENDA MILITAR</i></p> 	<p>País europeo</p> 
Pepita	Te cagas	

	<p>Tipo de diarrea</p> <p>TK</p> 	
---	--	--

Test 6

Adivinar mediante mímica la siguiente frase

1. Vivir en la verdad para conquistar mi libertad.
2. Defender la justicia y luchar por un mundo nuevo.
3. Ser comprensivo con los demás y exigente conmigo mismo.
4. Fortalecer mi espíritu, para estar dispuesto a servir a Jesús y a mis hermanos.

Test 7

Tenéis que decir nombres de personas con cada letra del abecedario, cada nombre en menos de 10 segundos y en orden inverso del abecedario.

Test 8

Tienes que adivinar las siguientes preguntas.

- Algunos meses tienen 30 días y otros 31, ¿Cuántos tienen 28 días? **(Solución → Todos)**
- ¿Qué hace una vaca cuando sale el sol? **(Solución → Sombra)**
- Redondo como la luna y blanco como la cal, me hacen con leche pura y ya no te digo más. **(Solución → Queso)**
- Un árbol con doce ramas, cada una con cuatro nidos, cada nido siete pájaros y cada cual su apellido. **(Solución → Año, meses, semanas y días)**
- Me llegan las cartas y no sé leer, y aunque me las trago las se devolver. **(Solución → Buzón)**
- Por el aire se cruzan un helicóptero y un avión. ¿Cómo se llaman los pilotos? **(Solución → Por radio)**
- ¿Cuál es el animal que camina con las patas en la cabeza? **(Solución → El piojo)**
- Tengo ocho patas cargadas de ventosas y paseo por las rocas meciéndome en las olas. ¿Quién soy? **(Solución → El pulpo)**
- De celda en celda voy pero presa no estoy. **(Solución → La abeja)**
- Una vieja con un diente que llama a toda la gente. **(Solución → La campana)**
- ¿Quién fue aquel genial marino que de pie mantuvo un huevo y descubrió un mundo nuevo por acortar un camino? **(Solución → Cristóbal Colón)**
- Lo dibuja el japonés, lo hace el ladrón y la tienes por duplicado en tu camisa y pantalón. **(Solución → Manga)**

Test 9

Tienes que recitar la oración junior pero únicamente usando una vocal.

En el comienzo de mi juventud voy hacia ti, Jesús.
 Quiero marchar decidido por el camino que tú me marques,
 para que mi vida sea lo que tú esperas de ella.
 Tú eres mi mejor amigo; juntos marcharemos en equipo
 para que compartas conmigo el pan de la amistad
 y me enseñes a darlo generosamente a mis hermanos.

Fortalece mi voluntad para vencer mis pasiones,
cumplir siempre con mi deber
y seguirte sin cansarme con lealtad y alegría.

Annex 3

Routes

Route Team 1: 6 → 5 → 8 → 9 → 11 → 10 → 13 → 12 → 1

Route Team 2: 14 → 16 → 18 → 10 → 11 → 5 → 8 → 2 → 1

Route Team 3: 2 → 3 → 7 → 10 → 16 → 19 → 15 → 17 → 1

Hints to go to the next site

Name	Hint
Patronato	Lugar donde normalmente realizamos las sesiones
Monestir	Su construcción fue por orden de Mosén Melchor Hierro
Plaça Sant Tomas	Lugar donde algunas veces hemos hecho las cucañas
Llavador	Sitio donde se suele lavar la ropa
Mare de deu del Desemparats	Lugar donde se realiza fiesta el segundo domingo de mayo
Torre dels portuguesos	Lugar de una fortaleza donde se realiza vigilancia
L'Aljub	Fuente discreta que se confunde con una hornacina santoral
Mirador pont	Lugar desde donde podemos contemplar una de las entradas del pueblo
Carrer del Batle	Calle en honor a una antiguo cargo del pueblo
Placeta de la presso	Lugar donde Sant Blai fue hecho patron
L'Emboç	Una de las calles donde más cerca se encuentran una casa de la otra
Placeta lleó Ibèric	Plaza que tiene el nombre de una pieza arqueológica encontrada en los terrenos del pueblo
El tou	Lugar donde puedes aparcar cuando vas a la iglesia
La calça	Antigua puerta de acceso al barrio Medieval
Parque cantereria	Parque donde podemos encontrar información sobre la ruta de Jaume I
Plaça cantereria	Lugar donde se encuentra una fuente que era sitio de descanso antes de acceder a la iglesia
Parque Barri medieval	Parque donde hay un antiguo depósito medieval
Ermida mare de deu dels Desemparats	Una ermita la cual fue construida después de la reconquista de Jaume I
Portal	Sitio por donde se podía acceder al pueblo
Mirador	Lugar desde donde podemos ver les covetes del moros
Iglesia	Está hecha en honor de Nuestra Señora de la Asunción

Pont Medieval	Lugar de acceso al pueblo más antiguo
---------------	---------------------------------------

Annex 4

Json of the equipment status

```
{
  "statusEquipment": [
    {"part": "Helmet", "adquired": false},
    {"part": "Tasset", "adquired": false},
    {"part": "Weapon", "adquired": false},
    {"part": "Shield", "adquired": false},
    {"part": "Cuirass", "adquired": false},
    {"part": "Greave", "adquired": false},
    {"part": "Pauldron", "adquired": false},
    {"part": "Vambrace", "adquired": false}
  ]
}
```

Code that ensures that the following is to be displayed

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.UI;
using System.IO;
using UnityEngine.SceneManagement;
using LitJson;

public class changeHero : MonoBehaviour {
    private JsonData elfData;
    private JsonData dwarfData;
    private JsonData humanData;

    public Text nameHeroe;
    public GameObject tubraeg;
    public GameObject [] tubraegObject;

    public GameObject tehlarissa;
    public GameObject[] tehlarissaObject;

    public GameObject raimund;
    public GameObject[] raimundObject;

    private string elfEquipJson;
    private string humanEquipJson;
    private string dwarfEquipJson;

    public GameObject changeHeroMenu;

    public void nextHero() {
        PlayerPrefs.SetInt("charView", PlayerPrefs.GetInt("charView") + 1);
        if (PlayerPrefs.GetInt("charView") > 2)
        {
            PlayerPrefs.SetInt("charView", 0);
        }
    }
}
```



```

    }
}

public void prevHero(){
    PlayerPrefs.SetInt("charView", PlayerPrefs.GetInt("charView") - 1);
    if (PlayerPrefs.GetInt("charView") < 0){
        PlayerPrefs.SetInt("charView", 2);
    }
}

private void Start(){
    elfEquipJson = File.ReadAllText(Application.dataPath +
"/scripts/equipmentElf.json");
    humanEquipJson = File.ReadAllText(Application.dataPath +
"/scripts/equipmentHuman.json");
    dwarfEquipJson = File.ReadAllText(Application.dataPath +
"/scripts/equipmentDwarf.json");

    elfData = JsonMapper.ToObject(elfEquipJson);
    dwarfData = JsonMapper.ToObject(dwarfEquipJson);
    humanData = JsonMapper.ToObject(humanEquipJson);

    if (PlayerPrefs.GetString("seeCharacters") == "Gallery"){
    }
    else if (PlayerPrefs.GetString("seeCharacters") == "Inventory"){
        changeHeroMenu.SetActive(false);
        switch (PlayerPrefs.GetInt("charSel")){
            case 0:
                showHuman();
                break;
            case 1:
                showElf();
                break;
            case 2:
                showDwarf();
                break;
            default:
                break;
        }
    }
}

private void Update(){
    if (PlayerPrefs.GetString("seeCharacters") == "Gallery"){
        switch (PlayerPrefs.GetInt("charSel")){
            case 0:
                showHuman();
                break;

```

```

        case 1:
            showElf();
            break;
        case 2:
            showDwarf();
            break;
        default:
            break;
    }
}
}

public void returnHome(){
    if (PlayerPrefs.GetString("seeCharacters") == "Gallery"){
        SceneManager.LoadScene("mainMenu");
    }
    else if (PlayerPrefs.GetString("seeCharacters") == "Inventory") {
        SceneManager.LoadScene("map");
    }
}

private void showDwarf(){
    nameHeroe.text = "Tubraeg";
    tehlarissa.SetActive(false);
    raimund.SetActive(false);
    tubraeg.SetActive(true);
    for (int i = 0; i < 8; i++){
        showPart(tubraegObject[i], 2, i);
    }
}

private void showHuman(){
    nameHeroe.text = "Raimund";
    tehlarissa.SetActive(false);
    raimund.SetActive(true);
    tubraeg.SetActive(false);
    for (int i = 0; i < 8; i++){
        showPart(raimundObject[i], 0, i);
    }
}

private void showElf(){
    nameHeroe.text = "Tehlarissa";
    tehlarissa.SetActive(true);
    raimund.SetActive(false);
    tubraeg.SetActive(false);
    for(int i = 0; i <8; i++){
        showPart(tehlarissaObject[i], 1, i);
    }
}

```

```

    }

    private void showPart(GameObject objectShow, int character, int index){
        bool status;
        switch (character){
            case 0:
                status = (bool)humanData["statusEquipment"][index]["adquired"];
                Debug.Log(index + " " +
                (bool)humanData["statusEquipment"][index]["adquired"]);
                objectShow.SetActive(status);
                break;
            case 1:
                status = (bool)elfData["statusEquipment"][index]["adquired"];
                Debug.Log(index + " " +
                (bool)elfData["statusEquipment"][index]["adquired"]);
                objectShow.SetActive(status);
                break;
            case 2:
                status = (bool)dwarfData["statusEquipment"][index]["adquired"];
                Debug.Log(index + " " +
                (bool)dwarfData["statusEquipment"][index]["adquired"]);
                objectShow.SetActive(status);
                break;
            default:
                break;
        }
    }
}

```

Creation of playerprefs and the logic of this screen in the main menu

```

using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;

public class mainMenu : MonoBehaviour
{
    public int characterView;
    public int characterSelected;
    public int historyText;

    public void Start(){
        characterView = PlayerPrefs.GetInt("charView");
        characterSelected = PlayerPrefs.GetInt("charSel");
        historyText = PlayerPrefs.GetInt("charView");
        PlayerPrefs.SetInt("historyText", 0);
    }
}

```

```

    }

    public void playGame(){
        SceneManager.LoadScene("history");
    }

    public void goGallery(){
        PlayerPrefs.SetString("seeCharacters", "Gallery");
        SceneManager.LoadScene("gallery");
    }

    public void quitGame(){
        Application.Quit();
    }
}

```

Management of the history text

```

using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using System.IO;
using UnityEngine.UI;
using System.Linq;

public class changeHistory : MonoBehaviour{
    public Text history;
    string file;
    string fileDirectory;
    string fileRead;

    public void Start(){
        readText();
        history.text = fileRead;
    }

    public void readText(){
        if (PlayerPrefs.GetInt("historyText") == 0){
            file = "startHistory.txt";
        }

        if (PlayerPrefs.GetInt("historyText") == 3){
            file = "tubraegHistory.txt";
        }
        else if (PlayerPrefs.GetInt("historyText") == 2){
            file = "tehlarissaHistory.txt";
        }
        else if (PlayerPrefs.GetInt("historyText") == 1){
            file = "raimundHistory.txt";
        }
    }
}

```

```
else if (PlayerPrefs.GetInt("historyText") == 4){  
    file = "finalHistoryfile.txt";  
}  
  
fileDirectory = Application.dataPath + "/text/" + file;  
  
List<string> filelines = File.ReadAllLines(fileDirectory).ToList();  
  
foreach (string line in filelines){  
    fileRead += line + "\n";  
}  
}  
  
}
```